DEVICE AND METHOD FOR SIMULATING OPHTHALMIC SURGERY

BACKGROUND OF THE INVENTION

The present invention relates to a device and method for reshaping a corneal surface of an eye for refractive correction by laser ablation, and more particularly to a device and method for simulating the reshaping of the corneal surface.

Various lasers have been employed for ophthalmic surgery applications including the treatment of various eye disorders such as glaucoma, cataract, myopia, hyperopia, and astigmatism. In order to correct some of these eye disorders a laser is used to ablate or remove a portion of the corneal surface of an eye in order to reshape the cornea. Typically, such laser refractive surgery is achieved through a plurality of ablated layers, the cumulative affect of the plurality of ablated layers attempting to remove a portion of the cornea to reshape the cornea to correct the curvature of the eye. However, before attempting laser surgery on the cornea, most laser systems in use require the ophthalmologist to practice the ablation on a piece of plastic or metal. Once the practice piece is completed it is necessary to estimate the corresponding depth of ablation in the cornea by using one or more conversion factors. Such conversions or estimates are only approximations and do not completely and accurately determine the depth of ablation. In some situations such estimates are no more than an educated guess that the ablation profile performed on the practice piece will correct an eye disorder in an actual human eye. Additionally, in one available system, the EXCALIBER manufactured by LaserSight Technologies, a visual profile of the ablated cornea is created. However, with the EXCALIBER, a test ablation is still performed on a plastic sample and the profile is created through estimated conversion factors.

It would be advantageous if a simulated ablation profile of a cornea could be constructed or generated without the use of a practice or test piece of synthetic material. The present invention is designed to obviate and overcome many of the disadvantages and shortcomings experienced with the use of a practice piece of material. The present invention eliminates the test ablation on a synthetic material and a computer is used to directly translate actual laser energy pulses into a three dimensional view of corneal stroma ablation. In this manner, the present invention simulates ophthalmic surgery for correcting a disorder of an eye without actually performing surgery on an eye.

SUMMARY OF THE INVENTION

The device for simulating ophthalmic surgery of the present invention comprises laser means for generating a laser beam, an array for sensing whether the laser beam has been projected at the array, and a computer system operatively connected to the laser means and the array, the computer system for actuating the laser means, for determining whether the array has sensed the laser beam, and for creating an ablation profile based upon whether the array has sensed the laser beam.

In another form of the present invention, a device for simulating an ablation profile of a cornea of an eye comprises a laser for producing a laser beam, an array of sensing devices for sensing whether the laser beam has been projected onto any of the sensing devices of the array, and a computer system operatively connected to the laser and the array, the computer system for actuating the laser and for determining whether any of the sensing devices of the array has sensed the laser beam, the computer system further producing a simulated ablation profile for determining whether the simulated ablation profile will correct an abnormal condition of an eye.

In still another form of the present invention, a method of simulating ophthalmic surgery comprises the steps of providing a laser for producing a laser beam, providing an array of sensor devices for sensing whether the laser beam has been projected at the array, and providing a computer system operatively connected to the laser and the array, the computer system for actuating the laser, for determining whether the array has sensed the laser beam, and for creating an ablation profile based upon whether the array has sensed the laser beam.

In light of the foregoing, it will be recognized that a principal object of the present invention is to provide an improved device for simulating ophthalmic surgery for correcting a disorder of an eye.

A further object of the present invention is to provide a device for simulating ophthalmic surgery which can be easily employed with highly reliable results.

Another object of the present invention is to provide a device for simulating ophthalmic surgery which can simulate the ablation profile of the cornea by directly translating actual laser energy pulses into a three dimensional view of the cornea.

A still further object of the present invention is to provide a device for simulating ophthalmic surgery which provides an energy profile which accurately predicts an ablation profile of the cornea and a keratometric appearance of an eye to be treated.

These and other objects and advantages of the present invention will become apparent after considering the following detailed specification in conjunction with the accompanying drawings, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagrammatic view of a device for simulating ophthalmic surgery constructed according to the present invention;

FIG. **2** is a flow chart of a program utilized to control the operation of the device shown in FIG. **1**;

FIG. **3** is a block diagram of a second preferred embodiment of a device for simulating ophthalmic surgery constructed according to the present invention;

FIG. **4** is a diagrammatic view of a third preferred embodiment of a device for simulating ophthalmic surgery having a fiber optic grid;

FIG. **5** is a perspective view of another fiber optic grid constructed according to the present invention; and

FIG. **6** is a partial cross-sectional view of the fiber optic grid shown in FIG. **5** taken along the plane of line **6**—**6**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like numerals refer to like items, number **10** identifies a preferred embodiment of a device for simulating ophthalmic surgery. The device **10** includes a laser **12** which is operable to produce a laser beam **14** which is directed to an array **16**. A computer system **18** is operatively connected to the laser **12** by electrical wires or leads **20** and to the array **16** via leads **22**. The energy of the laser beam **14** is measured prior to being directed at the array **16** and this information is stored in the computer system **18**. It is assumed that the energy of the